GRADE 12 DIPLOMA EXAMINATION

Chemistry 30

January 1989

Alberta
EDUCATION

GRADE 12 DIPLOMA EXAMINATION
CHEMISTRY 30

DESCRIPTION

Time: 2½ hours

Total possible marks: 70

This is a **CLOSED-BOOK** examination consisting of two parts:

PART A: 56 multiple-choice questions each with a value of 1 mark.

PART B: Three written-response questions for a total of 14 marks.

A chemistry data booklet is provided for your reference. Approved calculators may be used.

GENERAL INSTRUCTIONS

Fill in the information on the answer sheet as directed by the examiner.

For multiple-choice questions, read each carefully and decide which of the choices BEST completes the statement or answers the question. Locate that question number on the answer sheet and fill in the space that corresponds to your choice. USE AN HB PENCIL ONLY.

Example

This examination is for the subject area of

A. Biology
B. Chemistry
C. Mathematics
D. Physics

Answer Sheet

A	B	C	D
①	●	③	④

If you wish to change an answer, please erase your first mark completely.

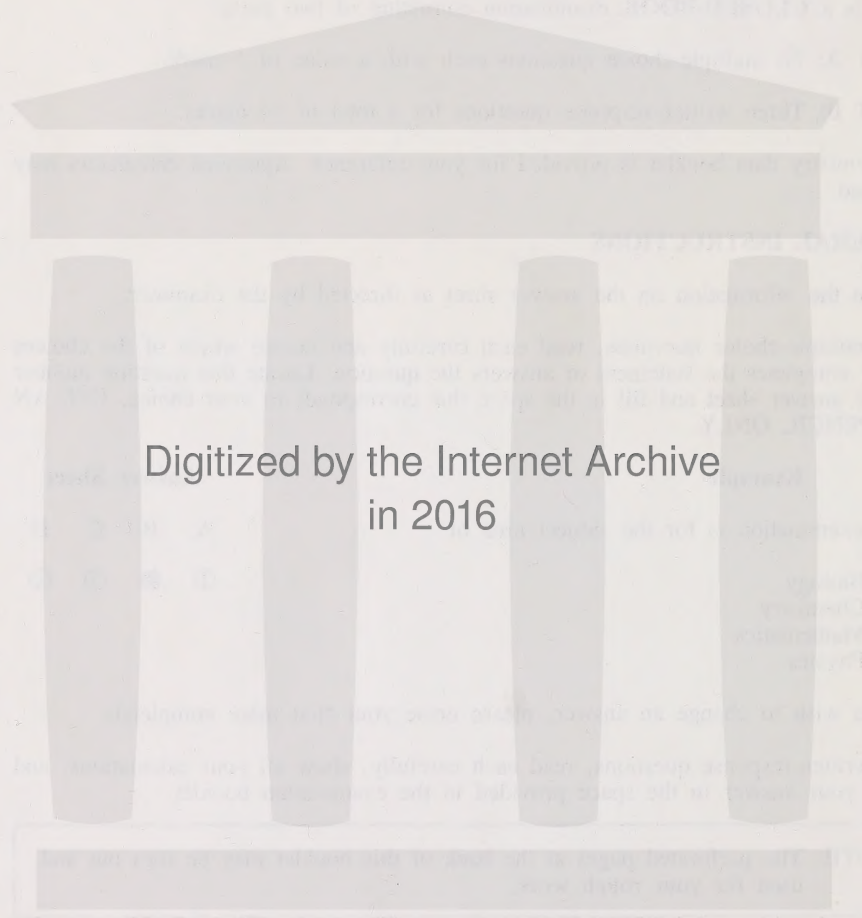
For written-response questions, read each carefully, show all your calculations, and write your answer in the space provided in the examination booklet.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

DO NOT FOLD EITHER THE ANSWER SHEET OR THE EXAMINATION BOOKLET

The presiding examiner will collect the answer sheet and examination booklet for transmission to Alberta Education.

JANUARY 1989



PART A

INSTRUCTIONS

There are 56 multiple-choice questions with a value of one mark each in this section of the examination. Use the separate answer sheet provided and follow the specific instructions given.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

WHEN YOU HAVE COMPLETED PART A, PROCEED DIRECTLY TO PART B

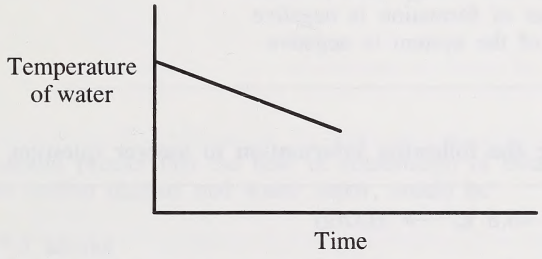
DO NOT TURN THE PAGE TO START THE EXAMINATION UNTIL TOLD TO DO SO BY THE PRESIDING EXAMINER

1. The heat of formation is

   A. another term for the heat of fusion
   B. the energy released when one mole of a compound is burned
   C. the energy involved as a substance goes through a phase change
   D. the energy involved when one mole of a substance is produced from its elements

Use the following graph to answer question 2.

A student performs an experiment using a calorimeter that contains water. The following is a graph produced from the data.



2. The best interpretation from the data is that the reaction is

   A. endothermic and that the kinetic energy of the water is decreasing
   B. endothermic and that the kinetic energy of the water is increasing
   C. exothermic and that the kinetic energy of the water is decreasing
   D. exothermic and that the kinetic energy of the water is increasing

---

3. The energy changes that occur when steam at 150°C gradually loses energy until it finally becomes ice at −50°C consist of a series of

   A. 2 potential energy changes and 1 kinetic energy change
   B. 2 kinetic energy changes and 1 potential energy change
   C. 3 potential energy changes and 2 kinetic energy changes
   D. 3 kinetic energy changes and 2 potential energy changes

4. If 9.54 g of magnesium react with excess oxygen, how much energy would be released?

   A. 2.36×10^2 kJ
   B. 3.28×10^2 kJ
   C. 4.72×10^2 kJ
   D. 5.74×10^3 kJ

5. Which reaction below gives the molar heat of formation for lead (II) oxide?

A. $Pb(s) + \frac{1}{2}O_2(g) + 217.9\ kJ \longrightarrow PbO(s)$

B. $2Pb(s) + O_2(g) + 435.8\ kJ \longrightarrow 2PbO(s)$

C. $Pb(s) + \frac{1}{2}O_2(g) \longrightarrow PbO(s) + 217.9\ kJ$

D. $2Pb(s) + O_2(g) \longrightarrow 2PbO(s) + 217.9\ kJ$

6. An endothermic reaction is a chemical reaction in which

A. reactants have more energy than products
B. reactants have less energy than products
C. the molar heat of formation is negative
D. the enthalpy of the system is negative

Use the following information to answer question 7.

I. $H_2O(l) + 40.8\ kJ \longrightarrow H_2O(g)$	
II. $2NO(g) \longrightarrow N_2(g) + O_2(g) + 180.8\ kJ$	
III. $2C(s) + H_2(g) \longrightarrow C_2H_2(g)$	$\Delta H = +226.7\ kJ$
IV. $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g)$	$\Delta H = -2043.9\ kJ$

7. As the reactions proceed, the potential energy of the system is decreasing for reactions

A. I and II
B. I and III
C. II and IV
D. II and III

---

8. A student vaporizes 23 g of $C_2H_5OH(l)$ in an insulated calorimeter that contains 0.400 kg of water. The temperature of the water changes from 91.3°C to 80.0°C. Using these data, the student's calculated value for the heat of vaporization of ethanol should be

A. 76 kJ/mol
B. 38 kJ/mol
C. 19 kJ/mol
D. 2.2 kJ/mol

Use the following information to answer question 9.

I. $UF_6(l) \longrightarrow UF_6(s)$

II. $U(s) + 3F_2(g) \longrightarrow UF_6(s)$

III. $^{238}_{92}U + {}^{1}_{0}n \longrightarrow {}^{239}_{92}U$

IV. $UF_6(g) \longrightarrow UF_6(l)$

9. A student should predict that the equation with a possible ΔH of -7120 MJ would be

A. I
B. II
C. III
D. IV

---

10. A student should predict that the heat of combustion of ethane gas, assuming the products are carbon dioxide and water vapor, would be

A. -1597.1 kJ/mol
B. -1560.0 kJ/mol
C. -1427.7 kJ/mol
D. -550.6 kJ/mol

11. A sample of natural gas consists of 8.0 mol methane and 2.0 mol ethane. Which of the following statements is true?

A. When ethane burns, it releases more heat per mole than methane.

B. For combustion, ethane requires less oxygen per mole than methane.

C. For combustion, the heat released per mole of mixture will be equivalent to that of methane.

D. For combustion, the heat released per mole of mixture will be less than that of methane but more than that of ethane.

12. Given the equation $CH_3COOH(l) + 2O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g)$, the heat of reaction is

A. +1758 kJ
B. +783.6 kJ
C. −783.6 kJ
D. −1758 kJ

Use the following data to answer question 13.

These data were obtained from the combustion of a sample in a calorimeter.

Amount of sample	3.86×10^{-2} mol
Initial temperature in calorimeter	22.54°C
Final temperature in calorimeter	23.82°C
Mass of water in calorimeter	2850 g

13. The heat of combustion for one mole of the sample calculated from the above data is

A. −0.590 kJ/mol
B. −15.3 kJ/mol
C. −94.4 kJ/mol
D. −396 kJ/mol

---

14. A student determined that 2.5 g of $CaCO_3(s)$ are formed by the reaction $CaO(s) + CO_2(g) \longrightarrow CaCO_3(s)$. The predicted quantity of heat released should be

A. 1.2×10^3 kJ
B. 1.8×10^2 kJ
C. 3.0×10^1 kJ
D. 4.4 kJ

Use the following information to answer question 15.

I. $6C(s) + 3H_2(g) \longrightarrow C_6H_6(l)$	ΔH_1
II. $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$	ΔH_2
III. $C(s) + O_2(g) \longrightarrow CO_2(g)$	ΔH_3
IV. $C_6H_6(l) + \frac{15}{2}O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(l)$	ΔH_4

15. The enthalpy change, ΔH_4, for reaction IV can be expressed as

A. $6(\Delta H_3) + 3(\Delta H_2) - \Delta H_1$
B. $6(\Delta H_3) - 3(\Delta H_2) + \Delta H_1$
C. $6(\Delta H_3) + 3(\Delta H_2) + \Delta H_1$
D. $-6(\Delta H_3) - 3(\Delta H_2) + \Delta H_1$

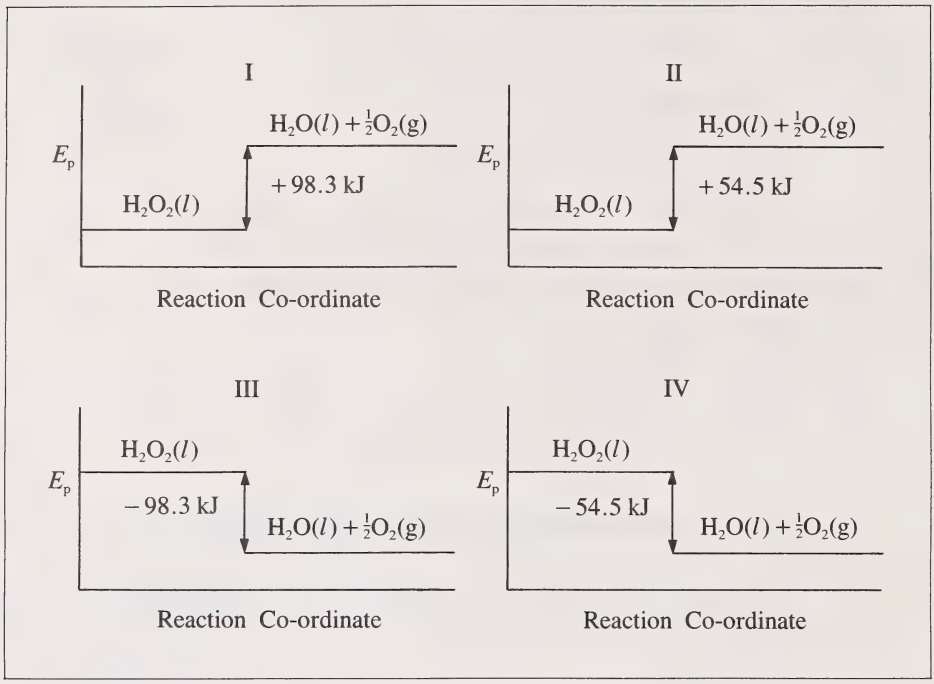
Use the following data to answer question 16.

A 2.00 g sample of hotdog weiner was burned in a calorimeter and the heat given off raised the temperature of 500 g of water in the calorimeter from 20.2°C to 30.4°C.

16. Calculate the energy that can be obtained from a 35.0 g weiner.

A. 1.22×10^2 kJ
B. 3.74×10^2 kJ
C. 7.49×10^2 kJ
D. 1.50×10^3 kJ

Use the following diagrams to answer question 17.



17. The standard enthalpy change for the reaction $H_2O_2(l) \longrightarrow H_2O(l) + \frac{1}{2}O_2(g)$ is represented by

A. I
B. II
C. III
D. IV

---

18. The heat of reaction for $SO_3(g) + H_2O(g) \longrightarrow H_2SO_4(l)$ is

A. −130.2 kJ
B. −174.3 kJ
C. −811.3 kJ
D. −1448.3 kJ

19. Which one of the following statements is valid?

A. A weak base ionizes completely in water.
B. A base may react with an acid to produce water.
C. A weak acid does not ionize at all in water.
D. An acid ionizes to produce hydroxide ions and water.

20. In the laboratory, an unknown solution was found to conduct an electric current and turn red litmus paper blue. A student should predict that the solution most likely is

A. $HNO_3(aq)$
B. $NaCl(aq)$
C. $Ba(OH)_2(aq)$
D. $CH_3COOH(aq)$

21. As solid NaOH is added to a solution of HCl, all of the following changes in solution properties should be observed EXCEPT

A. an increase in pH
B. an increase in $[OH^-(aq)]$
C. a decrease in $[H_3O^+(aq)]$
D. a decrease in conductivity

Use the following information to answer question 22.

25.0 mL portions of 0.10 mol/L solutions of $H_2SO_4(aq)$, $HCl(aq)$, and $CH_3COOH(aq)$ are contained in separate, unlabelled flasks. Simple laboratory tests are to be done to identify the solutions.

22. Which test could best identify one of the solutions?

A. The $H_2SO_4(aq)$ can be identified by the amount of $KOH(aq)$ that must be added to reach an endpoint using phenolphthalein.

B. The $HCl(aq)$ can be identified by its reaction with magnesium metal to produce hydrogen gas.

C. The $HCl(aq)$ can be identified by the red color that results when methyl orange indicator is added.

D. The $CH_3COOH(aq)$ can be identified by its sour taste.

---

23. According to Arrhenius, the substance that would be classified as an acid is

A. $CO_2(aq)$
B. $HCl(aq)$
C. $HCO_3^-(aq)$
D. $HPO_4^{2-}(aq)$

24. An aqueous solution of $KH_2BO_3(aq)$ is mixed with a solution of $KHSO_3(aq)$. The net ionic equation for the predominant reaction that would most likely occur is

A. $HSO_3^-(aq) + H_2O(l) \leftrightharpoons H_3O^+(aq) + SO_3^{2-}(aq)$

B. $H_2BO_3^-(aq) + H_2O(l) \leftrightharpoons H_3O^+(aq) + HBO_3^{2-}(aq)$

C. $H_2BO_3^-(aq) + HSO_3^-(aq) \leftrightharpoons H_3BO_3(aq) + SO_3^{2-}(aq)$

D. $H_2BO_3^-(aq) + HSO_3^-(aq) \leftrightharpoons HBO_3^{2-}(aq) + H_2SO_3(aq)$

Use the following equations to answer question 25.

I. $HBr(aq) + HSO_3^-(aq) \leftrightharpoons H_2SO_3(aq) + Br^-(aq)$

II. $HBb(aq) + I^-(aq) \leftrightharpoons HI(aq) + Bb^-(aq)$

III. $HClO_4(aq) + SO_4^{2-}(aq) \leftrightharpoons ClO_4^-(aq) + HSO_4^-(aq)$

IV. $HS^-(aq) + F^-(aq) \leftrightharpoons HF(aq) + S^{2-}(aq)$

V. $H_2CO_3(aq) + HPO_4^{2-}(aq) \leftrightharpoons H_2PO_4^-(aq) + HCO_3^-(aq)$

25. Equilibrium concentrations should be predicted to favor the products in equations

A. I, III, and IV
B. I, III, and V
C. II, III, and V
D. III, IV, and V

---

26. When litmus and phenolphthalein are used as indicators, a 0.1 mol/L solution turns litmus blue but phenolphthalein remains colorless. A student should make the interpretation that the solution is a

A. strong acid
B. strong base
C. weak acid
D. weak base

27. The pH of a 0.10 mol/L solution of benzoic acid is

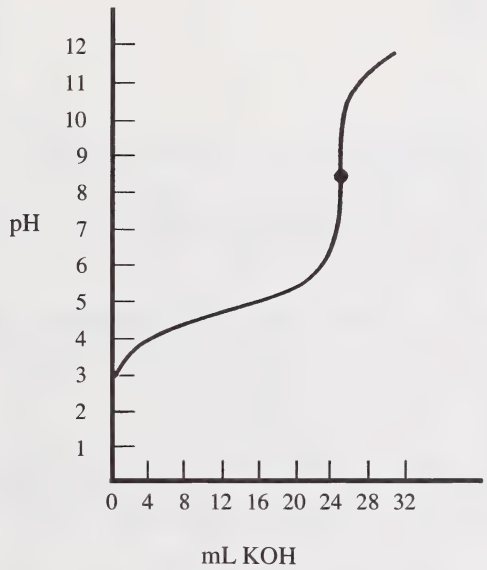
A. 0.60
B. 1.00
C. 1.40
D. 2.60

28. A sample solution turned yellow when methyl orange indicator was added. The yellow color was due primarily to the presence of

A. $H_3O^+(aq)$
B. $Mo^-(aq)$
C. $HMo(aq)$
D. $HMo(aq)$ and $Mo^-(aq)$

Use the following graph to answer question 29.

The graph below represents results from the titration of an acetic acid sample with a potassium hydroxide solution.



29. At the pH indicated by the point on the graph, the most abundant chemical species would be

A. $H_3O^+(aq)$, $OH^-(aq)$, $H_2O(l)$

B. $CH_3COO^-(aq)$, $K^+(aq)$, $H_2O(l)$

C. $CH_3COOH(aq)$, $KOH(aq)$, $H_2O(l)$

D. $CH_3COOH(aq)$, $OH^-(aq)$, $K^+(aq)$, $H_2O(l)$

30. The equation that does NOT represent a Brønsted-Lowry acid-base reaction is

A. $H_2O(l) + H_2O(l) \leftrightharpoons H_3O^+(aq) + OH^-(aq)$

B. $HS^-(aq) + HSO_4^-(aq) \leftrightharpoons H_2S(aq) + SO_4^{2-}(aq)$

C. $HCl(aq) + HCO_3^-(aq) \leftrightharpoons H_2CO_3(aq) + Cl^-(aq)$

D. $2Cl^-(aq) + 2H_2O(l) \leftrightharpoons H_2(g) + Cl_2(g) + 2OH^-(aq)$

31. If 2.00 g of NaOH(s) are dissolved in enough water to make 500 mL of solution, the $[H_3O^+(aq)]$ will be

A. 1.00×10^{-1} mol/L
B. 5.00×10^{-2} mol/L
C. 2.00×10^{-13} mol/L
D. 1.00×10^{-13} mol/L

Use the following data to answer question 32.

This titration involved a strong acid and a strong base. A student titrated 10 mL of solution and recorded the data as shown.

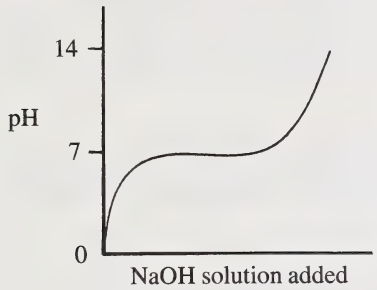
Reading #	Total # of mL added	pH meter reading
initial	0.0	2.00
1	0.6	2.05
2	0.9	2.07
3	1.2	2.10
4	1.5	2.13
5	2.0	2.17
25	10.0	7.00
26	10.5	—

32. The student should predict that Reading 26 would give a pH reading of

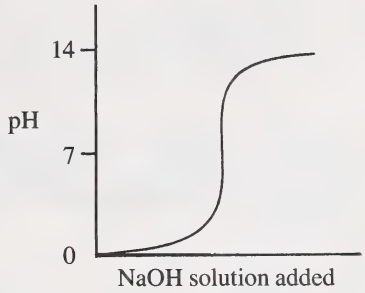
A. 7.05
B. 9.98
C. 10.39
D. 12.00

33. The electrode of a pH meter is immersed in distilled water. When a 1.0 mol/L NaOH solution is added to the water, the graph that illustrates the pH change is

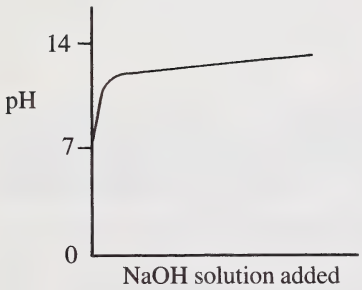
A.



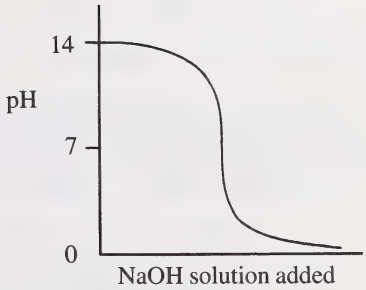
B.



C.



D.



34. A student performed a titration experiment in which it was observed that 1.5 mL of HCl(aq) were neutralized by 28.0 mL of 0.010 mol/L NaOH(aq). Which of the following would NOT significantly improve the accuracy of this experiment?

A. Use a KOH solution instead of the NaOH solution.
B. Make volume measurements to the nearest 0.01 mL.
C. Use a larger volume of the acid.
D. Perform more than one trial.

35. The volume of 0.40 mol/L KOH(aq) required to neutralize 0.080 L of 0.20 mol/L HNO_3(aq) is

A. 0.020 L
B. 0.040 L
C. 0.080 L
D. 0.16 L

36. 900 mL of 1.8 mol/L HCl solution are added to 300 mL of 0.40 mol/L NaOH solution. The resulting $[H_3O^+(aq)]$ is

A. 1.3 mol/L
B. 0.92 mol/L
C. 0.30 mol/L
D. 0.12 mol/L

37. A student considers the dissociation of an acid HA represented as $HA(aq) \rightleftharpoons H^+(aq) + A^-(aq)$. The observed pH of a 0.040 mol/L solution of HA is 2.00. The student should predict that the per cent dissociation of HA(aq) would be

A. 4.0%
B. 10%
C. 25%
D. 40%

38. During a redox reaction the

A. oxidizing agent is reduced and loses electrons
B. reducing agent is oxidized and gains electrons
C. oxidizing agent is reduced and undergoes an increase in oxidation number
D. reducing agent is oxidized and undergoes an increase in oxidation number

Use the following equations to answer question 39.

$$Fe^{3+}(aq) + 3e^- \longrightarrow Fe(s)$$
$$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$$

39. The substance that is being oxidized is

A. Zn(s)
B. Fe(s)
C. $Zn^{2+}(aq)$
D. $Fe^{3+}(aq)$

---

40. $Fe^{2+}(aq)$ reacts as a reducing agent in

A. $Fe^{2+}(aq) + Mg(s) \longrightarrow Mg^{2+}(aq) + Fe(s)$

B. $Fe^{2+}(aq) + 2Cl^-(s) \longrightarrow Fe(s) + Cl_2(aq)$

C. $3Fe^{3+}(aq) + Al(s) \longrightarrow Al^{3+}(aq) + 3Fe^{2+}(aq)$

D. $Fe^{2+}(aq) + Ag^+(aq) \longrightarrow Fe^{3+}(aq) + Ag(s)$

41. A student prepared an acidic solution of potassium dichromate five days in advance of its use for an electrochemical cell. When the cell was made it did not function as expected. The problem with the cell is that the acidic dichromate

A. was oxidized by the water in the solution
B. is a strong reducing agent and reacted with water in the solution
C. is a strong oxidizing agent and reacted with water in the solution
D. was oxidized by bacteria and organic matter found in the solution

42. When $Cl_2(g)$ reacts with $Br^-(aq)$ ions, the balanced net equation is

A. $Cl_2(g) + 2Br^-(aq) \longrightarrow 2BrCl(g) + 2e^-$

B. $Cl_2(g) + Br^-(aq) \longrightarrow Cl^-(aq) + Br(l)$

C. $Cl_2(g) + 2Br^-(aq) \longrightarrow 2Cl^-(aq) + Br_2(l)$

D. $Cl_2(g) + 2Br^-(aq) + 2e^- \longrightarrow 2Cl^-(aq) + Br_2(l) + 2e^-$

43. In balancing redox reactions, the oxidizing and reducing agents are assigned coefficients by making the equation consistent with the observation that, in any redox reaction, the

A. energy change of products equals the energy change of reactants
B. number of products equals the number of reactants
C. number of moles of products equals the number of moles of reactants
D. number of electrons gained equals the number of electrons lost

44. In acidic solution, the balanced half-reaction for the reduction of H_3AsO_4 to $HAsO_2$ is

A. $H_3AsO_4(aq) + 2e^- \longrightarrow HAsO_2(aq) + 2OH^-(aq)$

B. $H_3AsO_4(aq) \longrightarrow HAsO_2(aq) + O_2(g) + 2H^+(aq) + 2e^-$

C. $2H^+(aq) + H_3AsO_4(aq) + 2e^- \longrightarrow HAsO_2(aq) + 2H_2O(l)$

D. $2H_2O(l) + H_3AsO_4(aq) + 4e^- \longrightarrow 3HAsO_2(aq) + 4H^+(aq)$

Use the following information to answer question 45.

$$As_2O_3(s) + BiO^+(aq) + H_2O(l) \longrightarrow As(s) + H^+(aq) + Bi_2O_4(s)$$

45. When the equation is balanced using simplest whole numbers, the coefficient for $BiO^+(aq)$ is

A. 1
B. 2
C. 3
D. 6

Use the following data to answer question 46.

In a titration experiment, an acidified $Sn^{2+}(aq)$ solution was titrated with a 0.025 mol/L $KMnO_4(aq)$ solution causing all the $Sn^{2+}(aq)$ ions to be oxidized to $Sn^{4+}(aq)$ ions. The following data were obtained:

volume of $KMnO_4(aq)$	30.0 mL
volume of $Sn^{2+}(aq)$ ions	25.0 mL

46. The calculated concentration of the $Sn^{2+}(aq)$ ions in solution is

A. 7.5×10^{-6} mol/L
B. 4.7×10^{-5} mol/L
C. 1.2×10^{-2} mol/L
D. 7.5×10^{-2} mol/L

---

47. An electrolytic cell containing zinc nitrate solution was operated until 70.8 g of solid zinc were deposited at the cathode. How much chromium would be deposited if another cell containing chromium (III) nitrate was operated under the same conditions?

A. 9.39 g
B. 37.5 g
C. 84.5 g
D. 338 g

48. For an electrochemical cell the reaction $M^+ + P \longrightarrow P^+ + M$ produced an $E^\circ_{net} = +1.00$ V. The half reaction $M^+ + e^- \longrightarrow M$ has an E° value equal to +0.75 V. What is the E° value for $P^+ + e^- \longrightarrow P$?

A. +1.75 V
B. −1.75 V
C. +0.25 V
D. −0.25 V

49. If $Ag^+(aq) + e^- \longrightarrow Ag(s)$ is assigned a potential of 0.00 V, then the potential for $Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$ is

A. −1.56 V
B. −0.040 V
C. +0.040 V
D. +1.56 V

50. The WEAKEST oxidizing agent in the following list is

A. Ca(s)
B. Cu(s)
C. $Ca^{2+}(aq)$
D. $Cu^{2+}(aq)$

Use the following information to answer questions 51 and 52.

A student prepared the following chart for background information to be used with the following two-step procedure.

Species	$Cr^{2+}(aq)$	$Cr^{3+}(aq)$	$I^-(aq)$	$I_2(aq)$
color in aqueous solution	blue	green	colorless	brown

STEP 1: A neutral solution was prepared containing $Cr^{2+}(aq)$, $I^-(aq)$, and phenolphthalein.

STEP 2: Hydrochloric acid was then added to the solution in Step 1.

51. The student's recorded observation following Step 2 should be that the solution changed color from

A. blue to brown
B. blue to green
C. colorless to green
D. reddish-blue (purple) to green

52. The observed color change was caused by

A. a redox reaction
B. an acid-base reaction
C. both acid-base and redox reactions
D. the phenolphthalein changing color

53. When a shiny iron nail is placed in a mixture of $Zn(NO_3)_2$ and $AgNO_3$ solutions, which products are most likely to form?

A. $Fe^{2+}(aq)$ and $Ag(s)$
B. $Fe^{2+}(aq)$ and $Zn(s)$
C. $Fe^{3+}(aq)$ and $H_2(g)$
D. $Fe^{3+}(aq)$ and $NO_2(g)$

Use the following information to answer question 54.

A new metal vaterium, Vt, has been isolated and it forms a soluble salt, $Vt(NO_3)_2$. An electrochemical cell is made using a Vt rod dipped in $Vt(NO_3)_2(aq)$ and a standard hydrogen half-cell. The cell generates 1.24 V and the hydrogen half-cell is the anode.

54. Which prediction should be made based on the above observations?

A. The reduction half-reaction is $Vt^{2+}(aq) + 2e^- \longrightarrow Vt(s)$ and the reduction potential is $+1.24$ V.

B. The oxidation half-reaction is $2H^+(aq) + 2e^- \longrightarrow H_2(g)$ and the reduction potential is 0.00 V.

C. The reduction half-reaction is $Vt^{2+}(aq) + 2e^- \longrightarrow Vt(s)$ and the reduction potential is -1.24 V.

D. The reduction half-reaction is $H_2(g) \longrightarrow 2H^+(aq) + 2e^-$ and the reduction potential is 0.00 V.

---

55. Identify the statement that distinguishes electrochemical cells from electrolytic cells.

A. Electrolytic cells require an electrolyte.
B. Electrochemical cells require a cathode and an anode.
C. Electrolytic cells require an external power source.
D. Electrochemical cells require a pathway so ions can move between cells.

56. The time required to produce 1.00 g of $Na(l)$ in a molten $NaCl(l)$ electrolytic cell when the cell is operating at 10.0 A is

A. 4.35 min
B. 7.00 min
C. 9.65 min
D. 420 min

YOU HAVE NOW COMPLETED THE MULTIPLE-CHOICE SECTION OF THE EXAMINATION. PLEASE PROCEED TO THE NEXT PAGE AND ANSWER THE WRITTEN-RESPONSE QUESTIONS IN PART B.

PART B

INSTRUCTIONS

Please write your answers in the examination booklet as neatly as possible.

Marks will be awarded for pertinent explanations, calculations, formulas, and answers. Answers must be given to the appropriate number of significant digits.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

TOTAL MARKS: 14

START PART B IMMEDIATELY

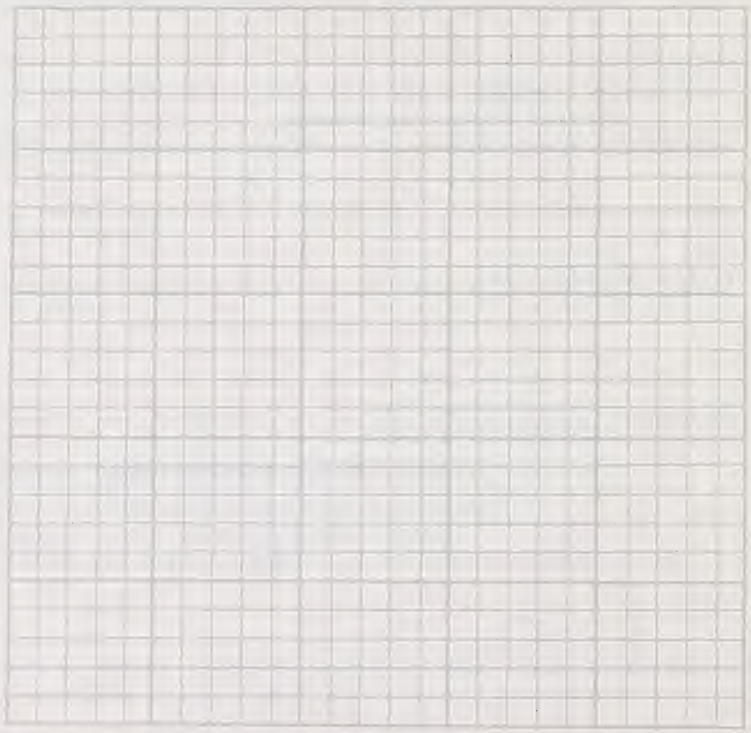
FOR DEPARTMENT USE ONLY

(6 marks)

1. A student wishes to estimate the molar heat of formation for heptane, $C_7H_{16}(l)$. The student observes an apparent trend in the heats of formation of the following alkanes:

Alkane		ΔH_f°(kJ/mol)
methane	$CH_4(g)$	−74.8
ethane	$C_2H_6(g)$	−84.7
propane	$C_3H_8(g)$	−103.8
butane	$C_4H_{10}(g)$	−124.7
pentane	$C_5H_{12}(l)$	−146.4
hexane	$C_6H_{14}(l)$	—
heptane	$C_7H_{16}(l)$	?
octane	$C_8H_{18}(l)$	−208.4

a) Plot the above data and estimate the molar heat of formation of heptane, $C_7H_{16}(l)$.



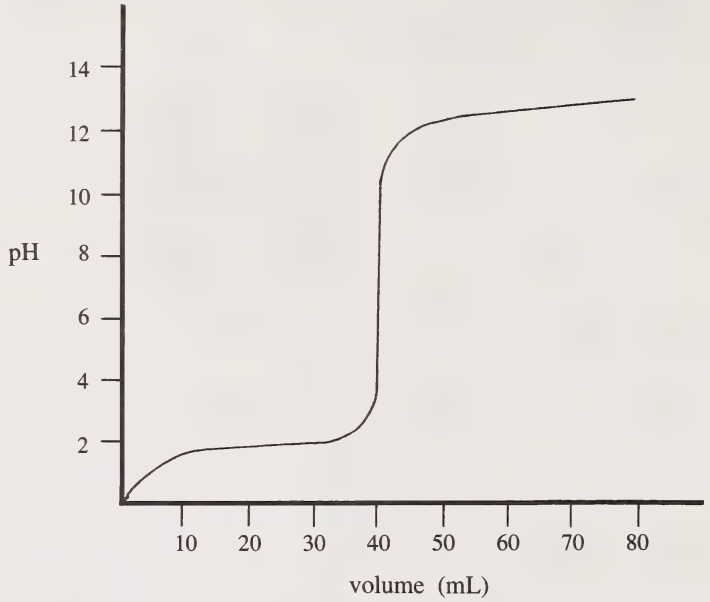
FOR DEPARTMENT USE ONLY

b) Support this method of estimating the molar heats for the alkane series. Use chemical principles you have learned about molecular substances and heats of reactions to explain why this process is well suited to the alkane series of compounds.

FOR DEPARTMENT USE ONLY

(4 marks)

2. A 20.0 mL sample of 0.020 mol/L HCl solution was titrated with a 0.010 mol/L $Ba(OH)_2$ solution. The following graph resulted from the collected data.



Identify two features of the graph that do not agree with the information in the description of that titration. Describe how the graph should be for each of these features and provide a supporting calculation for each correction identified.

FOR DEPARTMENT USE ONLY

Use the following information to answer question 3.

You are given the following metals and solutions of their ions:

Cu(s) and $Cu^{2+}(aq)$
Ni(s) and $Ni^{2+}(aq)$
Fe(s) and $Fe^{2+}(aq)$

3. Draw a diagram of an electrochemical cell that would produce a voltage of 0.18 V. Label the cathode and the anode. Name the metals and the solutions used. Use an arrow to indicate the direction of the flow of electrons. **(4 marks)**

YOU HAVE NOW COMPLETED THE EXAMINATION. IF YOU HAVE TIME, YOU MAY WISH TO GO BACK AND CHECK YOUR ANSWERS.

TEAR-OUT SHEET

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

TEAR-OUT SHEET

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

TEAR-OUT SHEET

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

TEAR-OUT SHEET

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

TEAR-OUT SHEET

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

FOR DEPARTMENT USE ONLY

M1 M2 M3 M4

FOR DEPARTMENT USE ONLY

CHEMISTRY 30

NAME: (LAST NAME) (FIRST NAME) DATE OF BIRTH: Y M D SEX:

PERMANENT MAILING ADDRESS: _____

(Apt./Street/Ave./P.O. Box) (Village/Town/City) (Postal Code)

SCHOOL CODE: SCHOOL: _____ SIGNATURE: _____

FOR DEPARTMENT USE ONLY

CHEMISTRY 30